cansats in europe

2014 european competition · gamma team

SCHULZENTRUM SII UTBREMEN

TEAM GAMMA

Design Document – Team Gamma

Bremen, Germany

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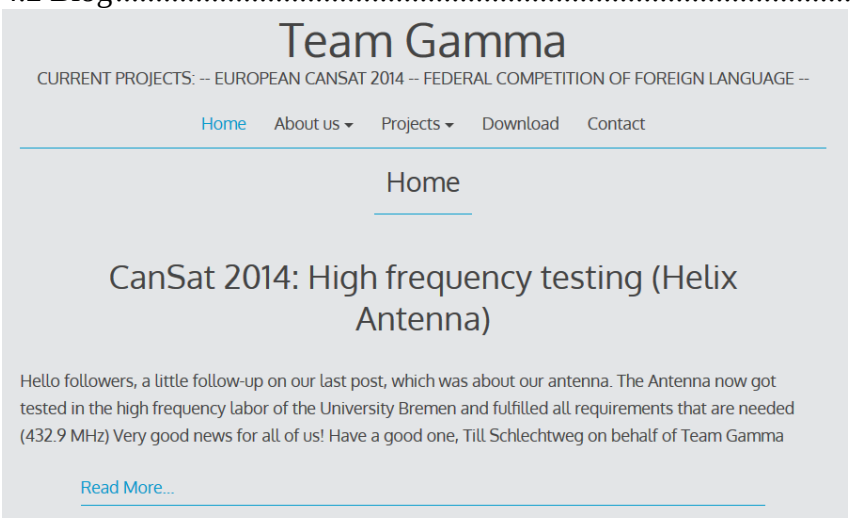
Team Gamma
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CanSat 2014: High frequency testing (Helix Antenna)
Hello followers, a little follow-up on our last post, which was about our antenna. The Antenna now got tested in the high frequency labor of the University Bremen and fulfilled all requirements that are needed (432.9 MHz) Very good news for all of us! Have a good one, Till Schlechtweg on behalf of Team Gamma
Read More...

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1. Introduction

1.1 The Idea of Apollo 12

One of our early ideas was to measure radioactivity of the surrounding area with our CanSat, after some research on the topic of radioactivity we let the idea fall down, because the tubes that measure these kinds of radioactivity need hundreds of volts and are not really suitable for a can. Now our idea is to make a fully open sourced CanSat, where we will publish all information for hobbyists or people that are just interested in the topic.

Not only the hardware part of the CanSat which mostly contains sensors and the CanSat kit are important, but also the software which is essential to get an overview of what is happening with the CanSat and the surroundings. So the idea was to make a fast and easy way to see data in real time so we would not have to hold a laptop in our hands at all times. So we thought a little about it and asked ourselves "what is tiny and can be carried around easily?" – of course one item that most people already have available – the smartphone. That leads us to our android application which has three ways for receiving data.

Nonetheless our laptop will not be left behind, it will have its own application to see data in real time and also save the data for later analysis. The application will transmit data to a database, to make the data available for everyone that sees our website.

Some ideas came a little later than others, for example the GPS tracking to see where our CanSat is located and to have a near spot-on reference value for our pressure sensor which calculates the height. The android application will show the Apollo 12 location if there is Wi-Fi or mobile broadband available.

1.2 Team Structure

Our Team contains seven students, each one of them has got a task assigned to them as follows:

Alexander Brennecke (18) is one of our team leader and the main spokesperson for our outreach program. To also give him some work with the CanSat he will develop the Android Application front-end, which means that he will develop everything UI (User Interface) related. At school Mr. Brennecke dedicates as much time as possible (depends on our teachers and school workload) and more than seven hours a week in one of our school labors which is reserved for us. His interests lie in the topic of software, which will be one of the main factors in his future work life, Mr. Brennecke loves to develop and debug software so the work given to him is very interesting for himself. He has one of the biggest but not hardest workloads, he is the one talking directly to sponsors and giving the blog (part of the outreach program) new posts and information, as well as fiddling with the Android SDK (Source Development Kit).

Till Schlechtweg (17), the second team leader, has the responsibility is to keep the team communicating between groups and to also develop and construct the CanSat. This means doing the Electrical Layout and the programming of the Atmel ATMEGA2560, which is the Arduino's Microprocessor. He has to fiddle with a lot of C for the programming and also has to handle the flood of datasheets for every component we need. His time dedicated is similar as Mr. Brennecke's: He will take as much time as possible within school and more than seven hours a week in the reserved labor at school. His interests lie in the field of engineering hardware and computer science. His workload is quite high, because all members lack the experience to develop the hardware components. So a lot of research needs to be done by him and his partner.

Kevin Neumeyer (17) is the second member of the developing and constructing group at Team

Gamma. He is – as Mr. Schlechtweg – responsible for getting the CanSat up and running, which means that the CanSat translates all data to a format which is chosen by us and also getting the data from all sensors in the first place. Mr. Neumeyer also has to search for the right components needed for our CanSat. They need to be fast as the CanSat will be falling at a speed more than 8m/s and less than 11m/s, which means milliseconds of response time are needed. Also most of the components need to be quite power efficient, because the battery needs to last one hour. They need to run on five Volts if possible. So Mr. Neumeyer and Mr. Schlechtweg as the hardware group have quite a workload which is constantly helped with by the whole team. Mr. Neumeyer is also our specialist for developing web applications so he will also develop the live.team-gamma.de website which will display a live graph of the measured data received.

Robin Bley (18) is our android application developer. As well as Mr. Brennecke he has to fiddle with all the Android SDK related stuff and is responsible for the back-end part of the android application. This contains all data handling as well as making a solid connection between the ground station and the android application. This will be made possible with a Java socket connection through a WLAN Hotspot started with our laptop. He needs to obtain the knowledge to complete the task of transmitting and receiving data with the Java socket, he also needs to know the format and how to get specific information needed from it. His interest lies in the topic of software developing and planning, he also would like a job in that general direction.

Alexander Ciupka (16) is part of our ground station group which will build the antenna needed for our specified frequency and also the software needed to see all the data in real time and to get a good overview of the CanSat and its flight. Mr. Ciupka specific task is to develop the connection between our MySQL database and the laptop which will get all the measurement data from our CanSat. The MySQL connection is essential for our CanSat, because the live.team-gamma.de website needs a quick and easy way to obtain measured information. He generally takes care of the back-end part of our laptop application that will handle everything connection related and also will handle the data format. Mr. Ciupka's workload is quite high, because no one has real experience with frequency and antennas, so we get external help from our University Bremen located nearby.

Marc Huisinga (17) is the second member of the ground station group. He will help with building our antenna with specific requirements. The front-end part of our laptop application is also developed by Mr. Huisinga. The front-end part will contain the graphs with measurement data and everything related to our measurements as well as options to save and export data in various formats. He needs to research for the knowledge of the GUI (Graphical User Interface) library in Java which will be Swing. The workload of Mr. Huisinga is high, because GUI development is not easy – lots of fiddling – and building an antenna with no prior knowledge is a big task to do.

Alexander Feldmann (17) is pending between our ground station and hardware group, because he has the task of building the antenna with Mr. Ciupka and to design and construct a prototype parachute. The parachute will be designed to give the CanSat a safe way to land and to be in the requirements of falling speed of 8 to 11m/s and the fall period with a maximum of 120 seconds. His workload is basic. Mr. Feldmann is more of a basic helper with all the tasks and he is boosting the team morale. Still the building of an antenna as well as a parachute is not an all-day task, as stated in Mr. Huisinga's and Mr. Ciupka's paragraph.

The time dedicated by Marc Huisinga, Till Schlechtweg, Alexander Feldmann, Alexander Ciupka, Robin Bley and Kevin Neumeyer is exactly the same as Mr. Brennecke's time management. The time we can offer at school and the time we dedicate specifically to CanSat at one of our school labors which is less than or more than seven hours, depending on the week and private dates.

1.3 Mission Objectives

Our secondary mission is to make a really easy to use, plug and play ground station that is available to all people even with no prior knowledge. This means everyone can operate our CanSat after a brief instruction, which includes android application and windows application.

We will also write a user handbook for our ground station and the android application. This means everyone can use these softwares without requiring an instruction from us.

We want to measure various values, these being

- Temperature
- Humidity
- Pressure
- Acceleration (X, Y, Z)

and also collect data for easy position tracking using GPS. We will also use the pressure collected from the primary mission to get an accurate value calculated physically to confirm the GPS location and the height of our CanSat and also to have a reference value for further analysis.

Also measured data will be available to the public via our website and can be easily exported to various formats these being:

1. CSV – A simple table format just with commas
2. TXT – Default notepad file
3. BMP – Windows Bitmap (image format)
4. XLS – Microsoft Excel Format
5. KML – Google Earth 3D Path Format
6. Print the data formatted on DIN A4

This makes analysis of the data very easy. For example you could look on your excel spread sheet, you see some interesting values you want to investigate, look up the position in 3D and you have everything you need.

We want to get people involved in seeing data and us being transparent, so everything we will do is open source and will be uploaded when finished (because of competition purposes). Our data will be available online if Andoya has a solid connection to the internet. If not the data will be uploaded after the arrival of the CanSat, when an internet connection is available.

The location values are essential to determine where we measured the values, because it is always important that you can filter and analyze the data for false positives/values.

Everything is licensed under the General Public License, version 3.0, so we do not lose any rights on our code and documents, but still everyone can use and modulate our work to their liking, also no one has the right to use our documents and code commercially.

The progress reports, feedbacks, design document, code as well as pictures can be found under team-gamma.de/download/.

2 CanSat Description

2.1 Apollo 12 Requirements

To fulfill our mission the following requirements need to be completed:

1. CanSat
    a. Landing without destroying of the whole system
    b. Saving and logging the data to SD
2. Ground station
    a. Flawless receiving of data
    b. Exporting to the various formatting
        i. to .txt
        ii. to .csv
        iii. to .xls
        iv. to .bmp
        v. to printer
    c. Display of data
        i. in realtime
        ii. without errors
3. Android Application
    a. Flawless receiving of data
        i. per database
        ii. per ground station server
        iii. per file (import)
    b. Flawless exporting of data
        i. to .teamgamma
    c. Displaying of data
4. Antenna
    a. Can be deconstructed
    b. Works in the right frequency

The following requirements are optional:

1. CanSat & Antenna
    a. Receiving data while the CanSat is in air
    b. Making photos
2. Ground station
    a. Easy to use and user friendly
        i. Other languages
        ii. Simple menu
    b. Exporting of data
        i. to .kml
3. Android Application
    a. Sidebar
    b. Easy to user and user friendly
        i. no random crashes
        ii. graphs can be modulated on their axises
4. Website
    a. Working live stream
    b. Displaying of values while the CanSat is in Air

2.2 Mechanical/Structural/Electrical Design

2.2.1 Antenna

The Yagi-Uda-Antenna is linear polarized that's why when the CanSat and the Yagi-Uda-Antenna align perfectly with each other nothing will be transmitted or received, and it's also the reason why we wanted to change the type of antenna we use.

After talking to professor doctor engineer Martin Schneider of the University Bremen, we came to conclusion of another antenna design not only the Yagi-Uda-Antenna. Mr. Schneider did say that the Helix Antenna is one of the best solutions for our project, because of the characteristics she offers.

For calculation of the Helix Antenna we consulted the professor stated above. There is

$$c = \lambda \cdot f$$

$$c = 3 \cdot 10^8 \frac{m}{s}$$

This states that the wavelength for

$$\lambda = \frac{c}{f} = 69{,}12cm$$

is the perimeter of our Helix. The squared length of our reflector is also the wavelength. For the diameter of our Helix, there is:

$$d = \frac{\lambda}{\pi} = 22cm$$

with N = 8 winds and the step height of

$$s = \frac{\lambda}{4} = \frac{69{,}12}{4} = 17{,}28cm$$

there is the length of our antenna with

$$l = 8 \cdot \frac{\lambda}{4} = 138{,}2cm\,.$$

The antenna gain is calculated with

$$G = 15 \cdot N \cdot s \cdot \frac{(\pi \cdot d)^2}{\lambda^3}$$

the step height being

$$s = \frac{\lambda}{4}$$

and N = 8 makes

$$G = 15 \cdot 8 \cdot \frac{\lambda}{4} \cdot \frac{\pi^2 \cdot \frac{\lambda^2}{\pi^2}}{\lambda^3}$$

which is

$$G = 15 \cdot \frac{8}{4} = 30\,.$$

For the impedance there is:

$$Z = 140\Omega \cdot \pi \cdot \frac{d}{\lambda}\,.$$

With

$$d = \frac{\lambda}{\pi}$$

it will be

$$Z = 140\Omega \cdot \pi \cdot \frac{\frac{\lambda}{\pi}}{\lambda} \approx 140\Omega .$$

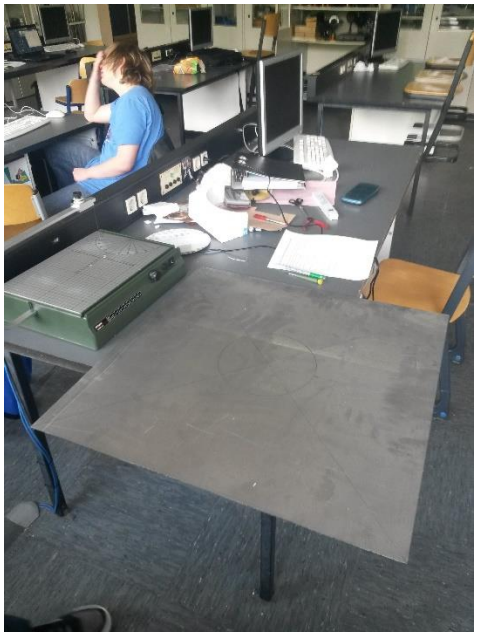


Fig. 1 - Reflector (Picture: Team Gamma)

The Antenna has a length of 138,2cm and the reflector or bottom plate is 69,12cm long. The impedance of our antenna needs to be 140Ohm, the impendance needs to be very exact that's why Mr. Schneider did help us with the adjustment of it.

Fig. 2 - Helix Antenna (Picture: Team Gamma)

The Antenna seen above was tested in the high frequency labor of the University Bremen, the antenna was also measured with a spectrum analyzer to see if it would fulfil our requirements of the wanted frequency.

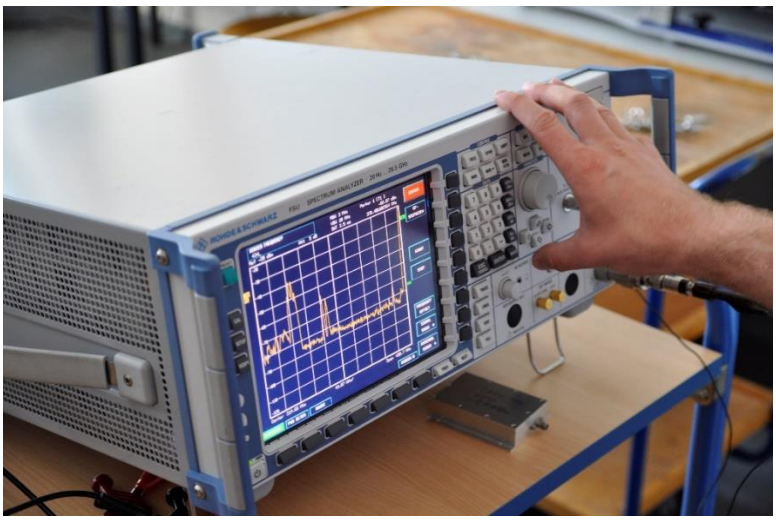


Fig. 3 - Spectrum Analyzer (Picture: Team Gamma)

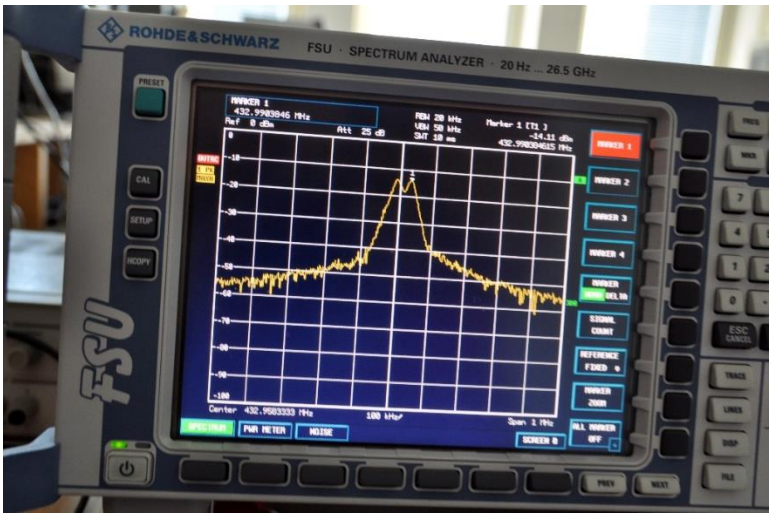


Fig. 4 - Spectrum Analysis of our Antenna (Picture: Team Gamma)

As you can see the frequency is nearly spot on, 432.9 MHz is a pretty good reading, that we need to get a good connection to our Apollo 12.

Because of the flight we can't really transport the Antenna you see in Fig. 2, we needed a portable solution. That's why we build a second antenna which can be deconstructed.

Fig. 5 - Constructing the second antenna (Picture: Team Gamma)

This antenna is ideal for transport and can be deconstructed to almost the tiniest bit. Martin Schneider present in the background was the one to explain us how we can measure the antenna to see if it fulfilled our requirements of the wanted frequency and the easy transportation.

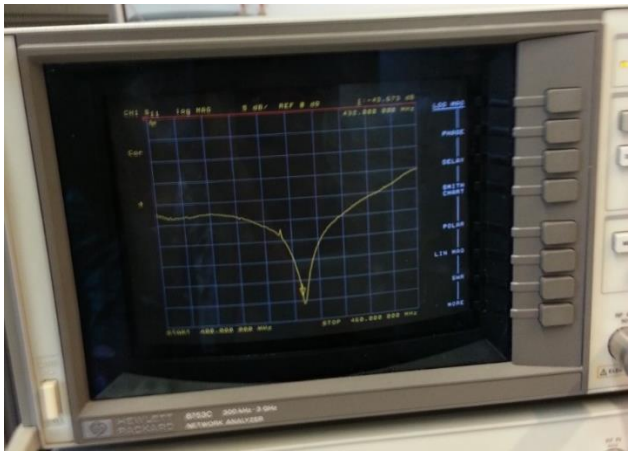


Fig. 6 - Reflection of our antenna (Picture: Team Gamma)

In Fig. 6 you can see that at the wanted frequency nearly everything will be received and on the other frequencies nearly everything will be reflected from our antenna, these are ideal environments for us to work with.

The bottom of the network analyzer means that everything will be received and the top means everything will be reflected. This is mostly driven by the wire being at the exact bottom, if the wire is too high from the reflector it will reflect more of the energy it receives and if you press it more towards the reflector plate (without touching) you receive more of the energy.

While the first antenna was built by gluing foam pads together and had a pure 69cm by 69cm metal reflector plate, the second antenna was constructed from aluminum pipes and plastic tubing for the holders of the actual copper wire. The bottom plate is pressure wood with aluminum foil.

2.2.2 The Can

2.2.2.1 Sensor Placement

We have to get many sensors in place and on our boards, the TMP006, the L3G4200D, the HIH-4000-001, a Micro SD Breakout, MPX4115A and the EM-411. The EM-411, which is a GPS sensor, will be placed on one of the blank boards and then the antenna will look out the front of our Apollo 12, that way it gets the optimal connectivity to them GPS satellites.

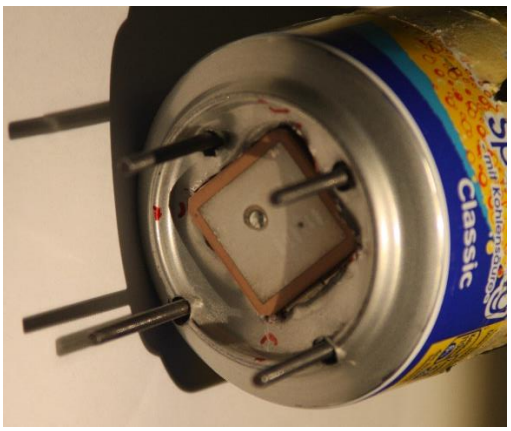


Fig. 7 - EM-411 looking through the top (Picture: Team Gamma)

The Micro SD Breakout will be placed on one of the through-hole boards together with the HIH-4000-001 Humidity Sensor and the TMP006 infrared temperature sensor. There is just enough room for these three to fit without interfering themselves.

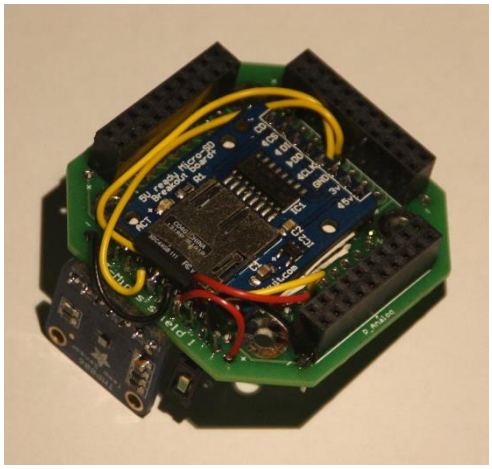


Fig. 8 - Top board (Picture: Team Gamma)

The L3G4200D, a gyroscope and the MPX4115A, a pressure senor have their own board, because the L3G4200D needs 3.3V and the T-Minus Board doesn't have a 3.3V Regulator build in., we needed a Z-Diode 3.3V and for current limitation an resistor in front of it. The resistor needs the resistance of

$$Rv = \frac{Uall - Uz}{Iall}$$

At first we need Izmax which is the maximal current the Zenerdiode can handle this is calculated with the help of Ptot which is the power loss of the Z-Diode, in this case we used a 3.3V Z-Diode which has 500mW power loss.

$$Izmax = \frac{Ptot}{Uz}$$

$$Izmax = \frac{0{,}5W}{5V}$$

$$Izmax = 100mA$$

Now we need the minimum current flow for which in this case we will consult the datasheet of the Zenerdiode.

$$Izmin = 1mA$$

Now we can calculate the whole current, which in this case is Izmax plus the gyrp current.

$$Iall = Izmax + IL$$

$$Iall = 100mA + 6.1mA$$

$$Iall = 106.1mA$$

Now we can calculate the resistor, which is there for protecting the Z-Diode, as follows:

$$Rv = \frac{5V - 3.3V}{0.1061A} = 16.0226\ Ohm$$

For the actual power loss on the Z-Didoe we will calculate:

$$Pz = Uz * Iall$$

$$Pz = 3.3V * 106.1mA$$

$$Pz = 350.13mW$$

With this calculation you can see that the Z-Diode with 500mW maximum power loss is more thatn enough to handle this situation. Now let's see what resistor we need, the resistor boosts our current a little bit.

$$Iall = \frac{Uges - Uz}{Rv}$$

$$Iall = \frac{5V - 3.3V}{16\ Ohm}$$

$$Iall = 106.25mA$$

The resistor needs a specific maximum power loss rating.

$$Prv = (Uall - Uz) * Iall$$

$$Prv = (5V - 3.3V) * 106.25mA$$

$$Prv = 180.625mW$$

For the resistor we need a minimum of circa 200mW power loss rating. We did choose a resistor with 300mW just to be safe.

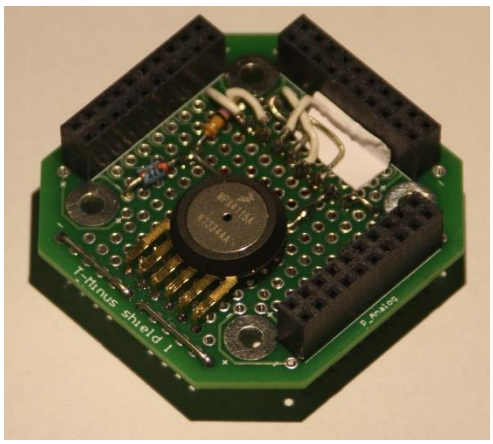


Fig. 9 - Middle board [top] (Picture: Team Gamma)

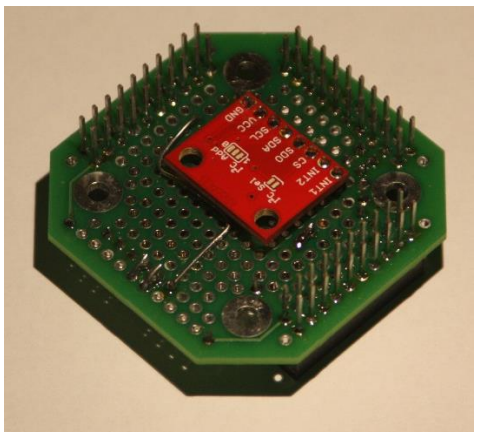


Fig. 10 - Middle Board [bottom] (Picture: Team Gamma)

At the top there is the EM-411 mounted on one of the back plates, then the SD, humidity and temperature board, after comes the pressure, acceleration board. Then the main µC-Board.

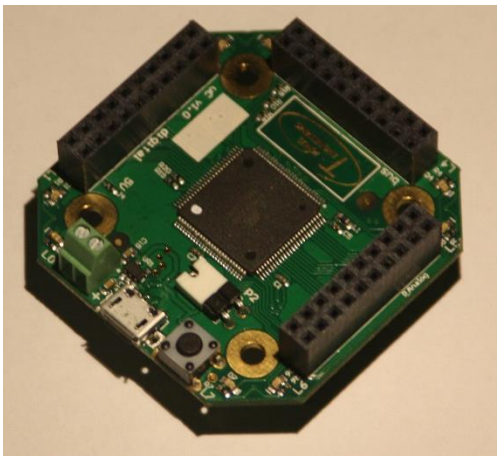


Fig. 11 - µC-Board (Picture: Team Gamma)

The next board is the transceiver.

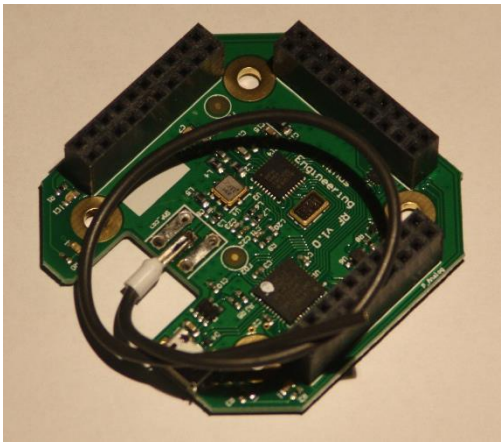


Fig. 12 - Transceiver (Picture: Team Gamma)

The whole construction from top to bottom looks like this:

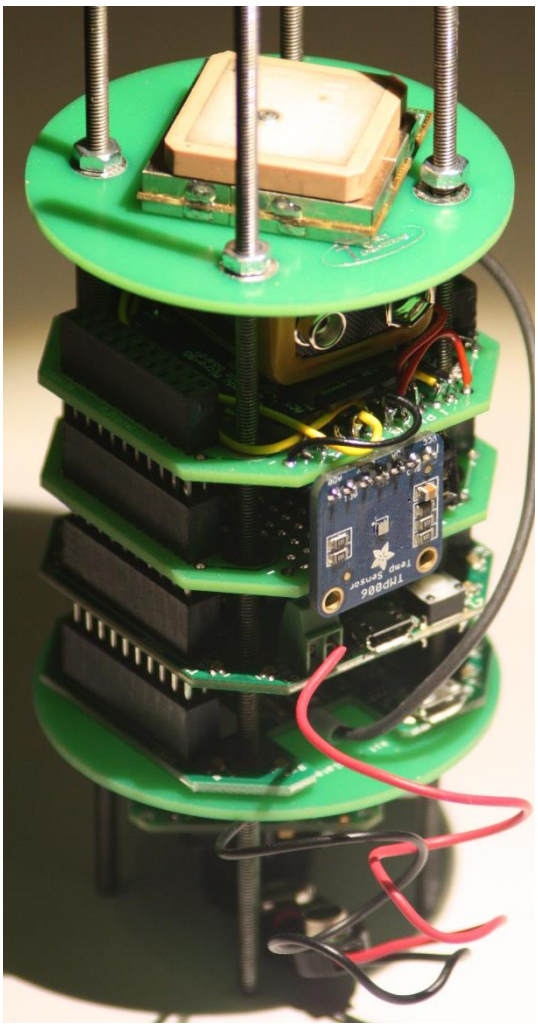


Fig. 13 - Apollo 12 (Picture: Team Gamma)

For the pin out of sensors see -> Appendix C. The infrared temperature sensor is focused on the Can, because the Can is very thin aluminum, the Can will adapt the outer temperature very fast. Everything will be glued together with hot glue, not the boards but rather the components to give them a snug hold when the rocket starts.

2.2.2.2 Outer Hull

The outer hull will be mostly held together by the long screws and nuts. As seen in this figure.

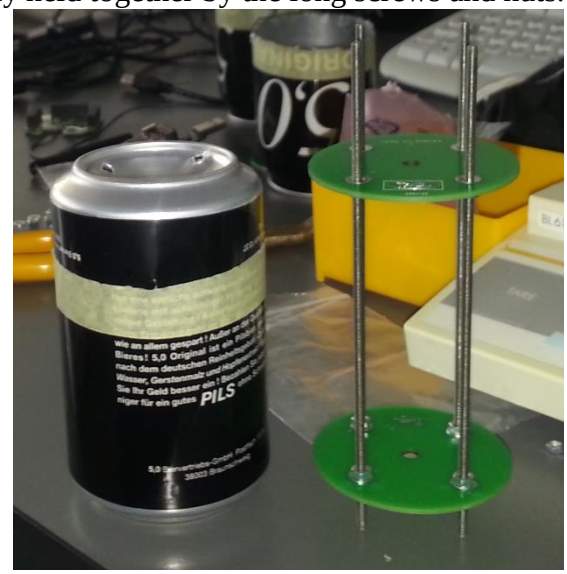


Fig. 1 - Outer Hull of Apollo 12 (Picture: Team Gamma)

This construction was tested under heavy G forces and withstood all tests. The tests were made possible by ATLAS ELEKTRONIK GmbH and their shaker. With the next figure we want to show you what we planned exactly. The screws will almost the whole force that will be present on our CanSat at the time of starting the rocket. If we want to open the CanSat we need to open four screw nuts then we can lift of the top half and the battery and power switch will be revealed.

Also we can lift out the entire Apollo 12 for inspection and/or repair.

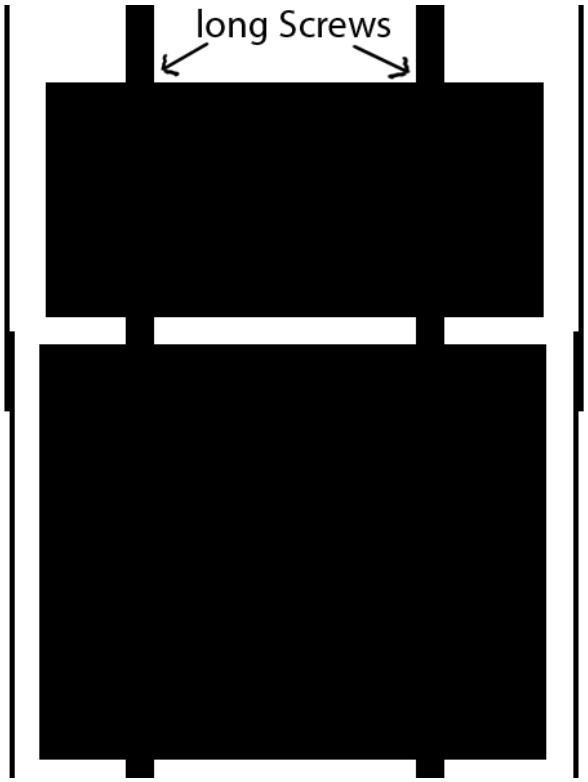


Fig. 14 – Hull (Picture: Team Gamma)

2.2.3 Battery

2.2.3.1 Battery Placement

The battery will be placed between the EM-411 and the SD Card board, as you can see in this picture:

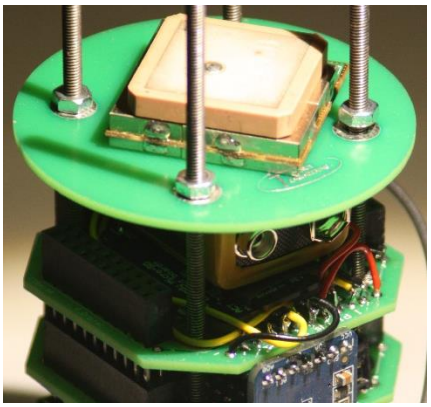


Fig. 15 - Battery Placement (Picture: Team Gamma)

2.2.3.2 Runtime

Sensor	mA	mV	mW	
TMP006	10	5	50	
EM-411	60	5	300	
L3G4200D	6,10	3,3	20,13	
HIH-4000-001	0,5	5	2,5	
MicroSD	150	5	750	
MPX4115A	10	5	50	
AtMega328	0,2	5	1	
			1173,63	mW

Fig. 16 - Power (Picture: Team Gamma)

As you can see our Apollo 12 needs a total of 1173.63mW to operate, this will be 236.8mA at different voltages. Our battery has a voltage of 9V, to calculate our mA usage at this level we will divide the total Watts through the battery voltage

$$\frac{1173.63mW}{9V} = 130.43mA$$

so we have 130.43mA at 9V. We need a minimum of $130.43mA * 3h = 391.31mAh$ to operate our Apollo 12 for three continuous hours. The AGFAPHOTO Extreme Power has a capacity of 550mAh and is enough to drive our Apollo 12 for

$$\frac{500mAh}{130.43mA} = 3.8h$$

The battery has enough capacity to power the Apollo 12 to the wanted requirements of three hours and a little puffer, because this is under ideal circumstances which will not be presented during launch and/or arrival.

2.3 Software Design

2.3.1 Android Application Design

2.3.1.1 Structural Design

2.3.1.1.1 Task

The main task of our android application is the visualization of every value we get from our Apollo 12. There are various different ways to obtain information. The values can be obtained from the database, a file, or the server running on our laptop. The application also shows the position from Apollo 12 and uses Google Maps to show exactly where it is located near us. The last task is to show our website team-gamma.de when you start the application.

2.3.1.1.2 Required Equipment

You only need a smartphone running Google Android with at least the version 2.3. Some devices with a too little screen will not or not probably show the application, because there is no time to develop the application for all screen sizes.

2.3.1.2 Data Coordination

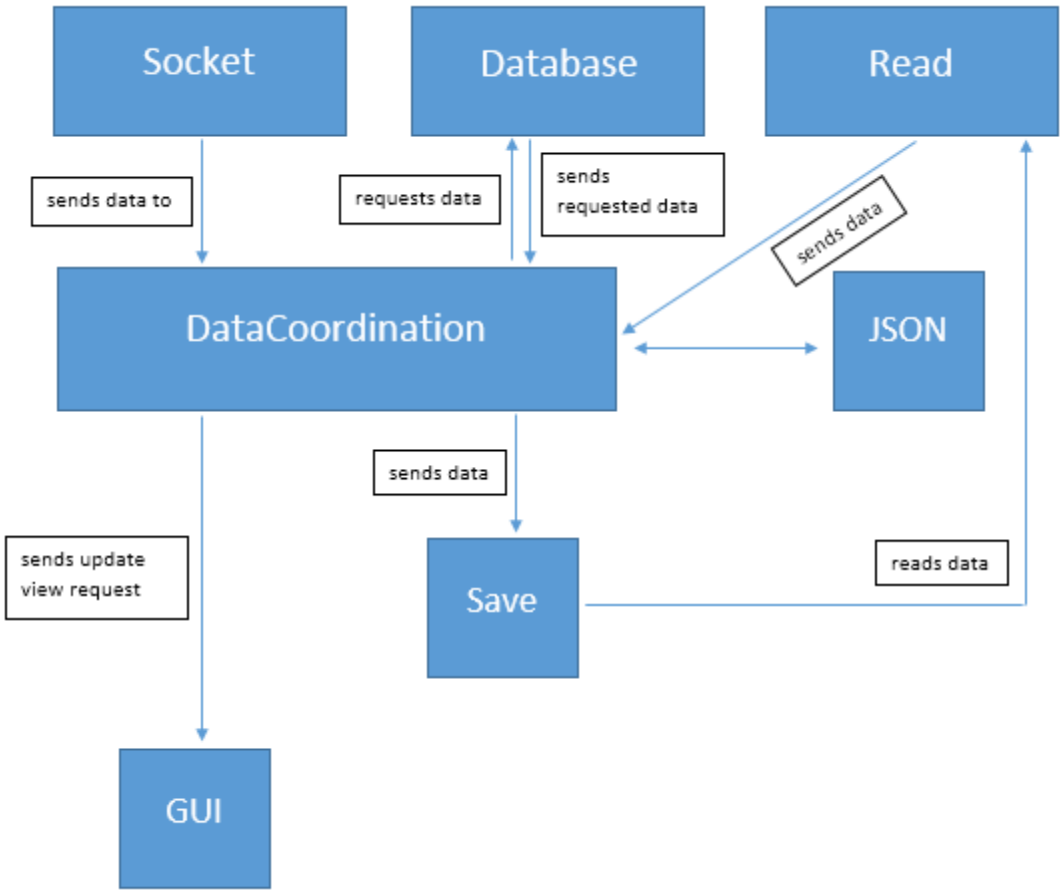


Fig. 17 - DataCoordination (Picture: Team Gamma)

The general design idea was to split the GUI and receiver parts as we did in our ground station that will be mentioned in the next section.

The *DataCoordination* as seen in the figure above is mainly to – as the name says – coordinate data to each different checkpoint. We have three ways of getting data:

1. Socket (Send from our laptop)
2. Database (MySQL)
3. Read (Data saved in files)

These can be selected directly in our android application. The *DataCoordination* looks up which way is selected and respectively gets all the data in this way formats them right, makes a sensor bbject for each sensor these will contain data of the sensor selected in the GUI. The GUI gets all the updated sensor objects and looks up which the user wants displayed, now the GUI gets the sensor bbject needed and displays the data from it.

The socket is just the way of sending sensor values from our laptop to our smartphone. The database is just the MySQL database created for our website, but is implemented here for a more redundant system. After the CanSat flight all values are saved in .txt files, if you still want to view the values that is no problem. Everything you need to do is select the read from file option and the data will be displayed.

2.3.1.3 Graphical User Interface

2.3.1.3.1 Main Design

Our Android App works with the Android Navigation Drawer (sidebar). The Android Navigation Drawer is located in the standard Android library and allows us to implement a sidebar which can be open by sliding from the left border of the smartphone to the middle. The user can also open it by pressing the button in the top left corner. When an element of this side menu is pressed a method gets the position of the pressed element based on his position and saves the position as an ordinal.

This number will be given to a switch statement, which is like a filter for determining what to do with the value. When the switch is called with the specific number, that is the position from the pressed element in the slide menu, it calls needed functions in the case of pressing the right button. In this case statement an object, which implements fragment, will be created and shown on the display. When a class implements fragment it gives the programmer the opportunity to display this class on the screen.

A class, which implements fragment, has a onViewCreate() method, which is called when an new object of this class is created, and returns a View. The View includes a layout file which is saved in an .xml file. In this layout file are text fields, buttons and any other kind of representable objects defined. The onViewCreate() method is also able to change the text of text fields and nearly every other representable object in the layout.

These two things allow us to easily change the displaying content by pressing one of the Navigation Drawer's elements.

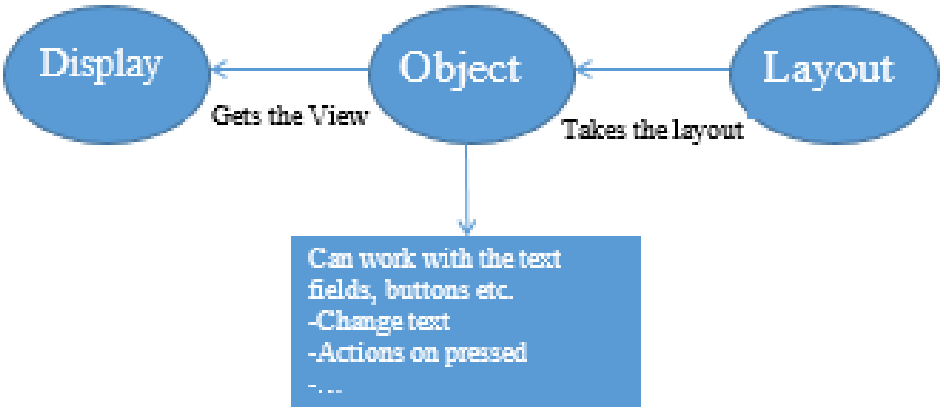


Fig. 18 - GUI workings (Picture: Team Gamma)

But this allows us only to display standard objects (buttons, etc.), which we need not mainly. Our main aim was to have a live chart which displays the actual data the satellite collects. For this we implemented the Androidplot library which allows us exactly that but with much less expenditure.

The Androidplot library is a free open source library which allows us to add a XYPlot to the .xml layout file. A XYPlot is able to show a coordinate system and to show values on these. With this features we are able to create a corresponding line chart in the application.

2.3.1.3.2 Options Menu

When we talk about options we mean everything the user can adjust in our application to his likings. For example this includes the number of shown values when the user watches the live stream or as another example the color in which the chart will be drawn. To make these options adjustable every time, we created a number of classes which include the different options.

As one example for these options there is a *ConnectionOptions.java* class which includes a number of Strings and every option has its dedicated String. There is one for the IP address, on for the Port and so on. The *ConnectionOptions.java* implements our own options interface. An interface has different functions which must be available in the class which implements the interface. This is important for our *Options.java* which creates an object of each options class (*ConnectionOptions.java* is only one example out of several classes which works with the same principle like the *ConnectionsOptions.java).*

The **Options.java** has a singleton pattern which allows us to create only one object of this class. This very important because if there are more objects of this class we would not have the same information in each object. But with the singleton pattern which basically just has a function to get the own Object from it *getInstance()*. Out of this object we can collect the data we need at the corresponding situations.

2.3.1.4 Data Transfer

2.3.1.4.1 Realtime

Connection to a server starts via java socket, over this connection we receive the JSON String messages. The messages are the measured values from Apollo 12. The String will be forwarded to the *DataCoordination*, which forwards the data to the *JSON* class. In this class the message will be casted to a JSONObject. With the help of the constant names Array in the *Values* class, the JSONObject will be iterated through and all Values will be written into the respective Sensor

object. The object will take 20 values and their respective timestamp. Every new value deletes the oldest value. The – by the user selected – sensor will be forwarded to the *realtimeGraph* class which displays it as a real time graph. All values will parallel be written into a file.

2.3.1.4.2 Recieval from File

The Read class opens a file and saves all values and their timestamp in an ArrayList of the type Values, which takes one value and one timestamp. The ArrayList will transmit these to a chart.

2.3.1.4.3 Recieval from Database

The connection with our database, will start at the *Databasecoordination* class. This class starts a new thread and takes the response from our database. The thread is the run-method of the *ConnectionRun* class which connects the database with the *Connection* class. The response will be casted to a JSONObject for easier analysis and the names of all sensor values will be given to the *Sensornames* class. The *DatabaseCoordination* gives the response from our database to the Sensordata class, which takes the values from the JSONObject and writes these to a ValuesList. The ValueList returns an ArrayList which will be transmitted to a chart.

2.3.1.5 Software exposition

The Javadoc is located at team-gamma.de/docs/app

2.3.1.5.1 Packages

2.3.1.5.1.1 widget

Contains only one class which gives us the option to add a vertical seek bar to a fragment.

2.3.1.5.1.2 data

This package contains static and constant variables. It also coordinate the data from the real time communication. The data will get from the Socket package as a String. All Strings will convert with the Json package to the right data types. The data will be transmitted to a class inside the Sensors package and then to the graph. Parallel will the data saved to files with help of the Fileoperations package.

2.3.1.5.1.3 database

The Database package is used to connect the app to our own database and get values of sensors from it. The values will transmitted to the graph.

2.3.1.5.1.4 filebrowser

Contains only one class which allows us to display the smartphone folder structure.

2.3.1.5.1.5 fileoperations

Here are all file operations executed. This packet is used to generate a separate file for each measurement and each sensor. Moreover, the data is read back here to view them.

2.3.1.5.1.6 fragments

Contains a class for each displaying fragment (without the androidplot fragments).

2.3.1.5.1.7 fragments_androidplot

Contains a class which can display values in real time and a class which can display imported values or values from our database.

2.3.1.5.1.8 json

In this package all messages will converted to their right data types. All messages, received from the Socket package, will be forwarded as a String to this Json package. Json creates a JSONObject which allows us to translate the data into a useable data format.

2.3.1.5.1.9 main

Contains the MainActivity which is called when the program starts.

2.3.1.5.1.10 options

Contains a class for each kind of options, a class which can handle with the different kind of options and an enum within the names, as keys, for the different types of options. Additional there is a class for the reading and writing in and out of the options.txt and a class which generates a new options.txt when the app starts its first time.

2.3.1.5.1.11 sensors

The Sensor package saves data to a Sensor object. This Sensor object contains 20 values and timestamps from one Sensor. For each new value, the oldest value will deleted and the new value will appended to the last index. The Sensor object will be transmitted to the graph to show the data.

2.3.1.5.1.12 socket

The Socket package provides the connection to the ground station. The Android Smartphone works as a Socket-Client and gets data from the ground station which works as a Socket-Server. The Server sends the message as a String to the Client (Android-Application). The Socket-Package forwards the String message to the Data-Package

2.3.1.5.1.13 value

This package works as a data type. The Value package contains the classes Value and ValueList. The Value class contains an Array of Double with two indexes. The first consists of a timestamp of a Value from a Sensor and the second consist of this respective Value. The ValueList is a class who append easily timestamps and Values to a Value Object and add this to a ArrayList.

2.3.1.5.1.14 webView

Contains one class which allows us to display our website into the application.

2.3.2 Ground Station Design

2.3.2.1 Structure

2.3.2.1.1 Task

The ground station is supposed to be the central point of communication. It is supposed to receive the data transmitted by the CanSat, transmit it to the smartphone application for our CanSat, log the data in a database, log the data in a local file, visualize the data and provide several options for visualizing the logged data.

2.3.2.1.2 Required equipment

The ground station was written in the interpreted programming language Java. To run the ground station you only need a computer that is capable of running Java and the interpreter JRE7.

2.3.2.3 Software Exposition

The Javadoc is located at team-gamma.de/docs/ground.

2.3.2.3.1 Packages

2.3.2.3.1.1 control

The control-package contains the controller for the entire program and the GUI-Controller. Both, as the same suggests, control certain parts of the program. The controller is the highest level access point of the ground station and serves as communicator and controller for every process in the software. The GUI-Controller mainly controls the graphical user interface of the software.

2.3.2.3.1.2 database

The database-package is responsible for the connection to the database and the sending of received data to the database.

2.3.2.3.1.3 export

The export-package is responsible for everything that is related to the exporting algorithms, the exporting menus and the display of the data. It contains the exporting panel which displays the exporting options, the exporting algorithms for the various file formats, and the display panel for the display of the data as graph and the display panel for the pictures logged by the CanSat.

2.3.2.3.1.4 livestream

The live stream-package does everything related to the display and the logging of the received data. It consists of the live stream panel, which displays the data using a graph and a text field, the live stream, which logs the data, generates random data in debug mode and inserts the received data into the live stream panel, and the TransmittedData, which contains the values and units that are being recognized by the ground station.

2.3.2.3.1.5 main

The main-package contains the MainFrame, which contains all the panels used for GUI-display, the MainMenuPanel, which serves as the display for the main menu, and the DefaultPanel, which contains several basic GUI configurations that are used in every panel of the GUI.

2.3.2.3.1.6 options

The options-package is responsible for the display of the options, using an OptionPanel, and the administration of all the options shown on the OptionPanel in OptionKeys.

2.3.2.3.1.7 server

The server-package is responsible for the java socket server. We need a server like this to send the data to our smartphone application. It contains the messages and the *Server* class: In the messages class we can create messages (data), which will be send to all clients on the Server. The *Server* class cares about the creation of the server and also handles the joined clients.

2.3.2.3.1.8 transmitting

The transmitting-package is, as its name implies, responsible for the transmitting of the received data to all other stations (smartphone application, website, etc.). It contains the Transmitter class, which just coordinate all the transmission work. Also it contains the TransmitOptions class, which tells the

Transmitter class where the data should send to.

2.3.2.3.1.9 usb

The usb-package contains the whole serial port connection, to read the received data from the antenna. It contains the USB class, which starts the serial port connection and also read the data from the serial port. Also it contains the Receiver class, which save the received data and tell the Transmitter class what to do.

2.3.2.4 Libraries

The ground station uses several external libraries so we do not have to reinvent the wheel for every single feature we wanted to implement. These libraries are the following:

- huisinga_libs: Utility library developed by Marc Huisinga (a member of Team Gamma) to provide with easy-to-use language and options components, which were used in the ground station to easily implement multiple languages and options saving.
- JChart2D: Library for the display of very fast graphs that can be updated in real time, used for the live stream display. JChart2D was developed by Achim Westermann and can be found under http://jchart2d.sourceforge.net.
- JFreeChart: Library for the display of very good looking graphs with multiple extra features and full configuration. We used this library in the ground station for the display of the logged data as a graph, to visualize a neat looking time-graph with several built-in features such as .pdf, .svg and .png export. JFreeChart was developed by Object Refinery Limited and is being maintained by David Gilbert. JFreeChart can be found under http://www.jfree.org/jfreechart/.
- Jssc (Java Simple Serial Connector): Library for the serial port connection. We used this library to create the connection to a serial port. JSSC can be found under: https://github.com/scream3r/java-simple-serial-connector/releases .
- Apache POI: We used this libraries for the xls exporter. With these libraries it's very easy to create Microsoft office files like .doc or .xls.

2.3.2.5 Livestream Design

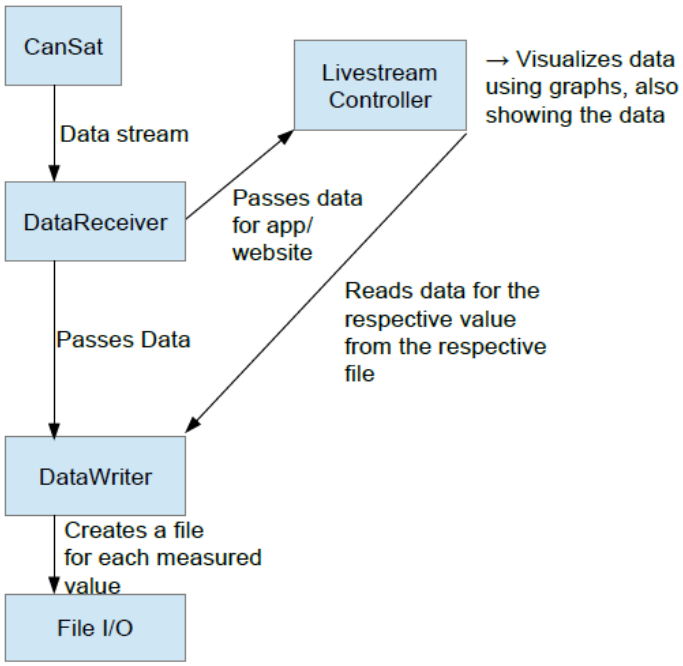


Fig. 19 - Livestream Diagram (Picture: Team Gamma)

The liv stream of our ground station and of our android application is essential, that's why we invest a lot of time just programming and designing this part of our mission. The ground station live stream is designed by Mr. Husisinga as shown in Fig. 19.

The CanSat sends its data to the *DataReciever* coded by Mr. Ciupka that will get the data via USB receiver, the data received will then be passed on to our *LiveStream Controller* which will display all the values on graphs and also show the values received in an nearby box. The *DataWriter* is a backup system, when you think about how the application saves values. As example the *LiveStream Controller* will save its data in variables and so that we have a redundant system alias crashes don't mean loss of data, we thought we need to directly save the values in an easy readable format, which will be just a the received JSON object in an txt file.

The *LiveStream Controller* is the one of the main components he houses just the logic to get everything up and running in a controlled way. We just showed the *Controller* here, because there is now good way to show everything GUI related. The GUI is also controlled by the *LiveStream Controller*.

2.3.3 General Design

2.3.3.1 MySQL Database

	#	Spalte	Typ	Kollation	Attribute	Null	Standard	Extra
☐	1	id	int(10)			Nein	*kein(e)*	AUTO_INCREMENT
☐	2	time	timestamp			Nein	CURRENT_TIMESTAMP	
☐	3	longitude	double			Nein	*kein(e)*	
☐	4	latitude	double			Nein	*kein(e)*	
☐	5	altitude	double			Nein	*kein(e)*	
☐	6	acceleration_x	double			Nein	*kein(e)*	
☐	7	acceleration_y	double			Nein	*kein(e)*	
☐	8	acceleration_z	double			Nein	*kein(e)*	
☐	9	pressure	double			Nein	*kein(e)*	
☐	10	temperature	double			Nein	*kein(e)*	
☐	11	humidity	double			Nein	*kein(e)*	

Fig. 20 - Table sensor_values

2.3.3.2 JSON

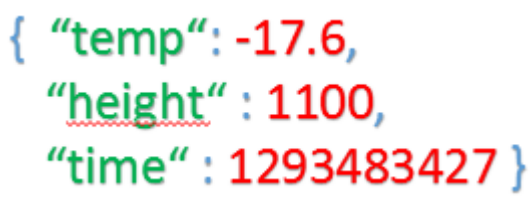


Fig. 21 - JSON format (Picture: Team Gamma)

JSON is a format for transmitting data very easy, it has a ready to go library for Java. We have no problems to get the data, analyze it and then save and/or work with them.

JSON has to main components these being an Object declared by these *{}* and arrays that are declared with *[]*. JSON makes it very easy to get the data, just by as example typing a little function call like this: *jsonobject.getDouble(‘temp’);* this would get the value of temp as double in this case -17.6 which then can be worked with.

We did chose JSON, because we don’t think it’s necessary to recode library’s or formats that are already available to the public and work like a charm. There is no point in doing a similar thing that has the worse properties than what we can’t even do. It shows that we can adapt on things and are willing to use the work of others to help us complete our tasks.

2.4 Recovery System

Symbol:	Values:	Unit:	Description:
G	9,81	m/s²	gravity
m	350	g	mass
p	1225	g/m³	density of air
C_d	0,75		airresistens
V	9	m/s	final speed
n	8		number of tiles

Ap	922,751323	cm²	area
d	32,93079209	cm	diameter
At	115,3439153	cm²	area of one tile

Diameter:

$$d = 2\text{sqrt}\frac{2A_p}{n * \sin\left(\frac{360^o}{n}\right)}$$

d 32,9307921

Area:

$$A_p = \frac{2gm}{pC_dV^2}$$

Ap 922,751323

Each Tile:

$$A_t = \frac{A_p}{n}$$

At 115,343915

Fig. 22 – Excel Spreadsheet for calculating parachute diameter and area (Picture: Team Gamma)

One idea to recover our CanSat was to cushion it via a CO_2 – Cartridge which would blast a little airbag out of our CanSat, but that idea was abandoned, because of missing knowledge, missing resources, it's dangerous and it needs space too much space. Now we have made some research on the topic of parachutes, how to build and calculate them. We have made an excel spreadsheet (Fig 1.) to calculate how big our parachute needs to be to brake our falling CanSat to the guideline speed.

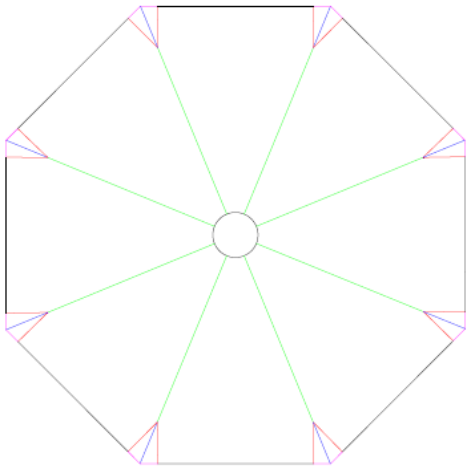


Fig. 23 – CAD of our Parachute (Picture: Team Gamma)

The next equation is for calculating the minimum needed area of our parachute, this originates from the book "Model Rocket Design and Construction", 2nd Edition, from Tim Van Milligan.

$$A_p = \frac{2gm}{pC_dV^2}$$

Fig. 24 – Formula for calculating the minimum area needed for a certain speed

You can then see that every tile has the area originating from the parachute area divided by the number of tiles. The final product looks like this:

Fig. 25 - The Final Product

2.5 Issues

In this Chapter we will list all major problems we came across and were stopping us develop our satellite. We think that this is a good way to step into our minds.

2.5.1 Hardware Error UART to USB Bridge

There is a hardware error on the UART to USB Bridge where when you code your own program to communicate with the bridge automatically turns RTS on, so the receiver goes in sleep mode. If you turn the RTS back off it goes back to sending data normally. RTS stands for Request To Send. CTS on the other hand means Clear To Send. The RTS signal is to indicate that the DTE requests the DCE to prepare for accepting data. DTE stands for Data Terminal Equipment which is in this case our Laptop the DCE (Data Communication Equipment) is the APC220, when you set RTS on it will not send anything, because it is now prepared to get data not to send it.

We were really intrigued by this and spent a lot of time finding the fix, for a not known problem but after many hours, we finally did manage to find a customer recession of the product which states the error and fix, which consists of just turning RTS off.

2.5.2 Sloth Sensors

In our guidelines it's stated that the CanSat needs to send data every second and ongoing. Still we had a little discussion on either we send data as soon as it's available, but having more problems working with it. Because it's like a MySQL database with a whole table full of nulls with the exception of the time field. We illustrated the two solutions and got with the first Solution.

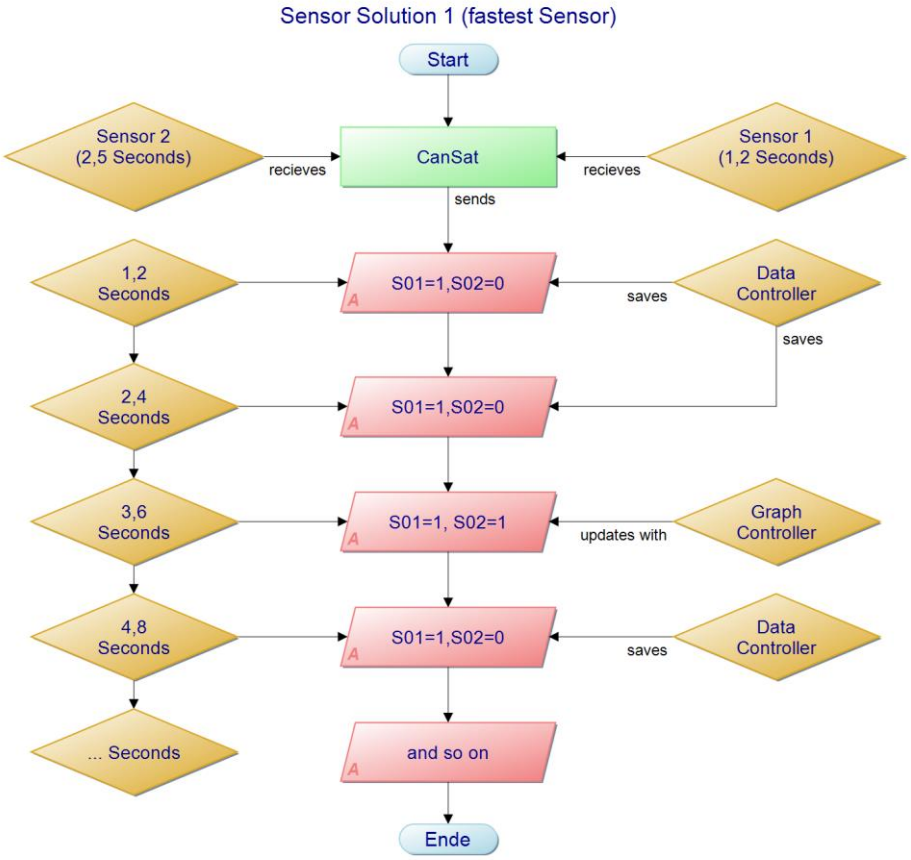


Fig. 26 - Solution 1 (Picture: Team Gamma)

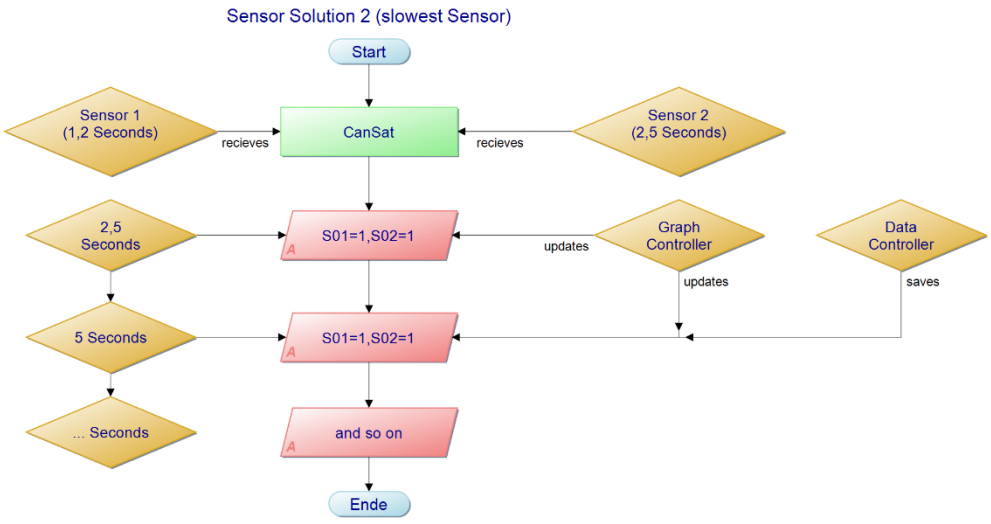


Fig. 27 - Solution 2 (Picture: Team Gamma)

Of course there would have been much more solutions to this problem, saving the data and then sending it and much more, but for our Apollo 12 these two were the best and we got with the first Solution.

2.5.3 CO_2

Because of the sloth sensors, described in 2.5.2 we had many issues finding fast sensors for measuring CO_2 and CO we cancelled these objectives to focus on the other issues we had. The CO_2 are sloth,

because of their heating element - which in some cases - needs a horrendous amount of time to heat up, before good measurements can be made.

(Standard test conditions)
Temperature and humidity: 20 ± 2℃, 65 ± 5% RH
Circuit conditions: Vc = 5.0±0.05V DC
V_H = 5.0±0.05V DC
R_L = 10.0kΩ ± 1%
Preheating period: 7 days or more under standard circuit conditions.

Fig. 28 – TGS 2600-B00 Specifications (not CO_2) (Picture: TGS 2600-B00 Datasheet)

These figures show that we could first of all only measure once in perfect conditions and also we would need about 7 days of preheating which on battery is nearly impossible.

Response time (90%)	>10sec
Resume time (90%)	>30sec

Fig. 29 – MD62 CO_2 Gas Sensor Specifications (Picture: MD62 Datasheet)

You could try and preheat the heating element yourself, but you're in risk of destroying parts that don't compensate for that heat.

We could have used other gas sensors, but all in all the searching of a suitable sensor was too time consuming. That's why the idea was completely abandoned.

2.5.4 Changing the Plan & Time Schedule

Because of many issues, which came to us while we were finished with the planning phase, we lost time and were in need to change our general Apollo 12 measuring plan. The components were ordered but they did arrive a week later than expected which did throw us back again.

Most of the components were tested fast and the plan for our construction was already completed, after placing everything were it should have been belonged, it didn't fit. Neither in the Can nor on the boards itself. We needed to change our plan again.

The Arduino Software was completed fast and was built to be able to change the PINs very fast and easy. The only problem was to engineer our CanSat the way we planned. In the end, we have invested a horrendous amount of time in the building of our CanSat, but we also planned enough time for this, that's why everything can still be finished as planned.

2.5.5 Arduino Crash (SoftwareSerial)

As we were beginning to code our Arduino or so to say the T-Minus main board. There was a problem that, if we would use the this-fix for our code and then try to access the Software Serial object we created to communicate with our GPS module. But after trying to see if data is available, the Arduino crashes and reboots. We did not find any fix or the actual problem. No one seems to have this kind of problem, because Arduino's IDE is not the best for bigger projects like this one.

2.5.6 Internal Guidelines

We have very strict internal guidelines and planning for everything there is between groups. Like code style, database structure, but not every member does fulfill these guidelines all the time, that's why sometimes we had issues that shouldn't have been there in the first place.

In the end, the making of these guidelines was very good and helped us a great amount in completing our Apollo 12 faster and without more problems than needed.

2.6.6 Arduino Memory leak Issue (JSON)

The Arduino never printed more than 12 JSON objects to the screen and then just stopped for a unknown reason. Our idea was that this was caused by a memory leak, so we used a library which is used for memory diagnostics (https://github.com/sudar/MemoryFree/) which offered a function to determine the remaining available memory.

First we stopped printing the JSON to the screen to make sure that we could track every possible error source. We saw that the free memory was decreasing a lot after reading, while reading the values, the Arduino creates aJsonObjects. After searching and trying to free the memory using the C++ delete operator we found the function *aJson.deleteItem(*aJsonObject)* to free memory used from **aJsonObjects**, after this we diagnosed that no more memory was leaked while reading the values.

```
char*
aJsonClass::print(aJsonObject* item)
{
  char* outBuf = (char*) malloc(256); /* XXX: Dynamic size. */
  if (outBuf == NULL)
    {
      return NULL;
    }
  aJsonStringStream stringStream(NULL, outBuf, 256);
  print(item, &stringStream);
  return outBuf;
}
```

Fig. 30 - The memory leak causing function (Picture: Team Gamma)

After this we started printing again and traced the memory after each dataset, after running the diagnostics we were sure there was another memory leak. We inspected the **aJson** library's print function, we searched for the implementation of the print function in the source files of **aJson**. As you can see in the screenshot the function allocates 256 bytes of memory used to store the JSON byte wise. Our problem was that the pointer returned by print was directly used as an argument for *Serial.println()* and so there was no reallocation of reserved memory, we changed our code so that the pointer was first stored in a local variable and was freed using *free(void *)* after printing our JSON to the screen, so the memory leaks were fixed.

3 Project Planning

3.1 Time Schedule of the CanSat Preparation

task name	start	end
1 planning	**Mon 20.01.14**	**Don 30.01.14**
1.1 specific definition of the project	Mon 20.01.14	Sam 25.01.14
1.2 find sponsoring partners	Don 23.01.14	Don 30.01.14
1.3 creating of PSP/PFP/MSP	Don 23.01.14	Don 30.01.14
2 general work	**Fre 31.01.14**	**Don 08.05.14**
2.1 develop Android App	**Fre 31.01.14**	**Don 08.05.14**
2.1.1 planning	**Fre 31.01.14**	**Don 13.02.14**
2.1.1.1 general planning	Fre 31.01.14	Don 06.02.14
2.1.1.2 specific defination and design	Fre 31.01.14	Don 06.02.14
2.1.1.3 UML and structure of the app	Fre 07.02.14	Don 13.02.14
2.1.2 develop	**Fre 14.02.14**	**Don 01.05.14**
2.1.2.2 GUI & easy display of data	Fre 14.02.14	Don 13.03.14
2.1.2.1 transmitting and recieving	Fre 14.02.14	Don 20.03.14
2.1.2.3 graphical display of data	Fre 14.03.14	Mit 09.04.14
2.1.3 testing the app	Fre 02.05.14	Don 08.05.14
2.3 developing of the ground station	**Don 23.01.14**	**Don 08.05.14**
2.3.2 datamanagment	**Don 23.01.14**	**Don 24.04.14**
2.3.2.1 research	Don 23.01.14	Mit 29.01.14
2.3.2.3 processing data	Fre 14.02.14	Don 13.03.14
2.3.2.4 forwarding via hotspot	Fre 14.03.14	Don 03.04.14
2.3.2.5 forwarding via database	Fre 04.04.14	Don 24.04.14
2.3.2.2 transmitting and recieving data	Don 30.01.14	Don 13.02.14
2.3.1 datahandling & GUI	**Don 23.01.14**	**Don 24.04.14**
2.3.1.1 research	Don 23.01.14	Mit 29.01.14
2.3.1.2 specific structure plan	Don 30.01.14	Mit 05.02.14
2.3.1.3 main menu and main threads	Don 06.02.14	Mon 10.02.14
2.3.1.4 add options	Die 11.02.14	Don 13.02.14
2.3.1.5 visualize the data	Fre 14.02.14	Don 20.03.14
2.3.1.6 export of data	Fre 21.03.14	Don 17.04.14
2.3.1.7 optional features	Fre 18.04.14	Don 24.04.14
2.3.3 testing phase	Fre 25.04.14	Don 08.05.14
2.2 construction of the CanSat	**Fre 31.01.14**	**Don 08.05.14**
2.2.2 JSON	Fre 07.02.14	Mit 12.02.14
2.2.3 parachute	**Fre 07.02.14**	**Don 13.03.14**
2.2.3.1 planing and construction	Fre 07.02.14	Mit 19.02.14
2.2.3.2 building and testing	Don 20.02.14	Don 13.03.14
2.2.1 general planning	Fre 31.01.14	Don 06.02.14
2.2.4 hardware	**Fre 07.02.14**	**Mit 09.04.14**
2.2.4.1 board layout	Fre 07.02.14	Mit 26.03.14
2.2.4.2 board soldering	Don 27.03.14	Mit 09.04.14
2.2.4.2 board soldering	Don 27.03.14	Mit 09.04.14
2.2.5 develop Arduino	Fre 07.02.14	Don 24.04.14
3 completed CanSat	Don 08.05.14	Don 08.05.14
4 testing the whole system	**Fre 09.05.14**	**Don 29.05.14**
4.1 testing hardware	Fre 09.05.14	Don 29.05.14
4.2 testing groundstation	Fre 09.05.14	Don 29.05.14
4.3 testing App	Fre 09.05.14	Don 29.05.14
5 competition in Norway	Mon 02.06.14	Fre 06.06.14
6 end of project :(	Mon 09.06.14	Mon 09.06.14

Fig. 31 – Time plan

3.2 Resource Estimation

3.2.1 Budget & Components

Budget is a very big factor for our project, so this is estimated very carefully. One of the bigger problems was to get financial support for the flight. From Germany there is no easy way to get to Andones Norway, our travel is were the most money lies. The Fig. 21 shows everything we estimated for sensors.

Number	Sensortyp	Description	Notes	Price	Articlenumber	Website	Quantity
1	Infrarot Temperatur	TMP006		13,80 €	ADA1296	Watterott	1
2	GPS Modul	Venus GPS		41,49 €	GPS-11058	Watterott	1
3	GPS Antenne	VTorch		10,54 €	GPS-00177	Watterott	1
4	Infrarot Temperatur	MLX90614		17,21 €	SEN-09570	Watterott	2
5	3-Achsen Gyro	L3G4200D		45,76 €	SEN-10612	Watterott	1
6	Temperatur&Feuchtigkeit	DHT22		11,62 €	ADA385	Watterott	1
7	Feinstaub Sensor	GP2Y1010AU0F		13,50 €	COM-09689	Watterott	1
8	OneWire Bus	OneWire X1		7,14 €	GHI452	Watterott	1
4	Infrarot Temperatur	MLX90614-AAA		13,80 €	647454	Distrelec	1
9	Feuchtesensor	HIH-4000-001		21,80 €	240583	Distrelec	1
10	GPS Modul	EM-408	3.3 V	34,90 €	667724	Distrelec	1
11	GPS Modul	EM-411	4.5 - 6.5 V	26,90 €	667723	Distrelec	1
12	Temperatur Modul	SMTIRMOD09STD		52,20 €	582209	Distrelec	1
13	1x7 Pol - Buchsenleiste 90°	216602-8		1,37 €	127298	Distrelec	1
14	1x8 Pol - Buchsenleiste	215297-8		1,00 €	122378	Distrelec	2
15	1x8 Pol - Female to Male	281695-8		1,00 €	127520	Distrelec	2

Fig. 32 – Spreadsheet for Sensors (Picture: Team Gamma)

The travel expense is about 2500€. The material cost for the antenna and some other equipment are not listed, because these were sponsored by ourselves, estimated about 500€

3.2.2 External Support

We did talk to many external companies and public media. Most of them did respond kindly. Rheinmetal Defense that they would really like to sponsor this project, because the love the idea, but they are currently in a not so good state for a company.

At OHB Systems GmbH we got an immediate response, because we had a contact person Frank Ellmers, from the external spokesperson that is Mr. Stade, he would arrange a meeting with Dr. Fritz Merkle that is a member of the executive board of OHB Systems GmbH and also a professor of nature sciences.

After this meeting, OHB Systems GmbH or more to say Mr. Merkle agreed to sponsor and help Team Gamma with the financial and other resources. Financially with 2500€ (two-thousand-five-hundred), with other resources we mean that for example there is a shaker at the OHB Systems GmbH which can simulate high G forces on our Can for testing purposes.

Watterott also agreed to sponsor us with their components, we can order 75€ (seventy-five) worth of sensors free of charge.

Distrelect is one of the late sponsors which agreed to sponsor us our needed components from their warehouse. Our contact person was Erik Gravenius, he and his company did sponsor us all the parts listed in the Figure in 3.2.1 Budget & Components.

3.2.3 Time

3.3 Test Plan

The whole system will be tested within the range of 09.05.2014 to 29.05.14. Everything will be already tested to that point in it on respect, everything together will be tested within these 20 days, as well as fixed and polished. It's a pretty tuff schedule but for us this is totally fine because we had enough time to probably build our Apollo 12 and all its software.

3.4 Test Results

As first test we did test the transmitter for the 1000m range and tried to send data, which in an open field is no problem (without a hull). As a second test we tried it with our Yagi-Uda-Antenna which was also successful over an even bigger distance (without the can).

4 Outreach Program

The outreach program of our Apollo 12 project contains a few aspects:

1. Social (Facebook, YouTube)
2. Blog (team-gamma.de)
3. Newspaper of Bremen (Weser Kurier)

4.1 Social

Everything we do will be recorded and then posted on our blog, but the videos will be uploaded to YouTube and a little status update with a link to our blog post will be posted on Facebook.

Cansat 2014 Team Gamma hat einen Link geteilt.
26. Januar
Today we were featured in one of our local newspapers -> read more: http://team-gamma.de/weser-kurier/
Team Gamma | Weser Kurier
team-gamma.de
Weser KurierHello followers,today we...
Gefällt mir · Kommentieren · Teilen
9

Fig. 33 - Example post (Picture: Team Gamma)

Facebook was chosen because nearly everybody has a Facebook account and can like and spread the word for our Apollo 12 and YouTube, because it's freely available and can be watched by everybody whenever they want.

4.2 Blog

Over at our blog everyone can follow our process of building the CanSat, getting a general overview over our mission and also to see if anything fancy happened, like sponsor partners and/or completing various task.

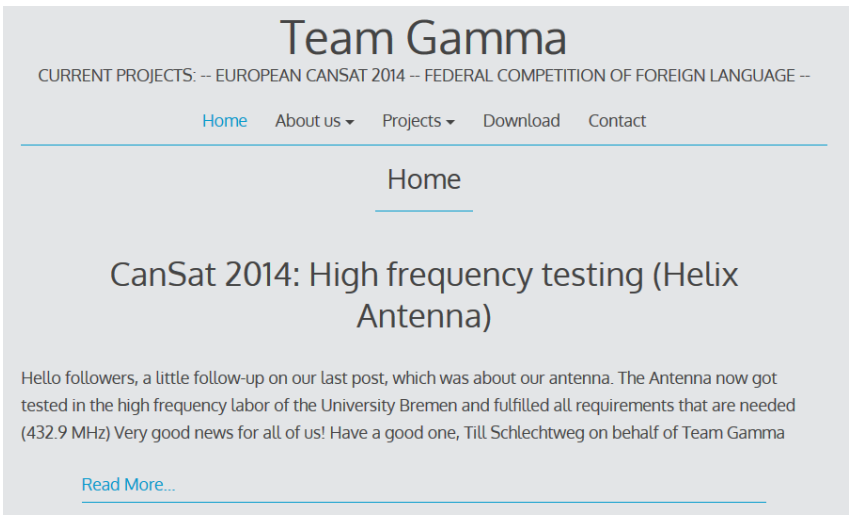

Team Gamma
CURRENT PROJECTS: -- EUROPEAN CANSAT 2014 -- FEDERAL COMPETITION OF FOREIGN LANGUAGE --
Home
About us
Projects
Download
Contact
Home
CanSat 2014: High frequency testing (Helix Antenna)
Hello followers, a little follow-up on our last post, which was about our antenna. The Antenna now got tested in the high frequency labor of the University Bremen and fulfilled all requirements that are needed (432.9 MHz) Very good news for all of us! Have a good one, Till Schlechtweg on behalf of Team Gamma
Read More...

Fig. 34 - Example Post (Picture: Team Gamma)

4.3 Logo Idea

We designed the logo with one of our main ideas in our back heads, simplicity we wanted to create something that is simple and good looking at the same time that is how we got the idea for our simple but still good looking logo. Also our team name which is related to the canceled idea of measuring radioactivity was also why we choose the gamma symbol for our logo.

Fig. 35 – Logo (Picture: Team Gamma)

4.4 Other

A presentation in our class also gave everyone an idea what we are doing and why. The whole class shared our Facebook fan page and is neatly following our progress as well as spreading the word.

The local newspaper here in Bremen, Germany is called the Weser Kurier which already published a news article about us and will publish one after or before the competition in Norway.

The internal newspaper of the OHB System AG will also have an article about us and how the OHB System AG interacts with us.

We are also in contact with a few more alternatives, which are the local television and some other newspapers/-sites.

5 Internal Guidelines

5.1 Language

Because our team is German, we needed a way of separating German and English and that's why we made a little table to see when to use German and when English.

English:

1. Code
    a. Comments
    b. Javadoc
2. Documents
    a. Progress Report
    b. Design Document
3. Social
    a. Facebook
    b. Blog
    c. YouTube

German:

1. Meetings
2. Dropbox
    a. Folder
    b. Files
3. Internal documents

5.2 Data Management

Data management is a very important factor for us, we need to overlook all the data we have, because at the moment of 28th May 2014, we have:

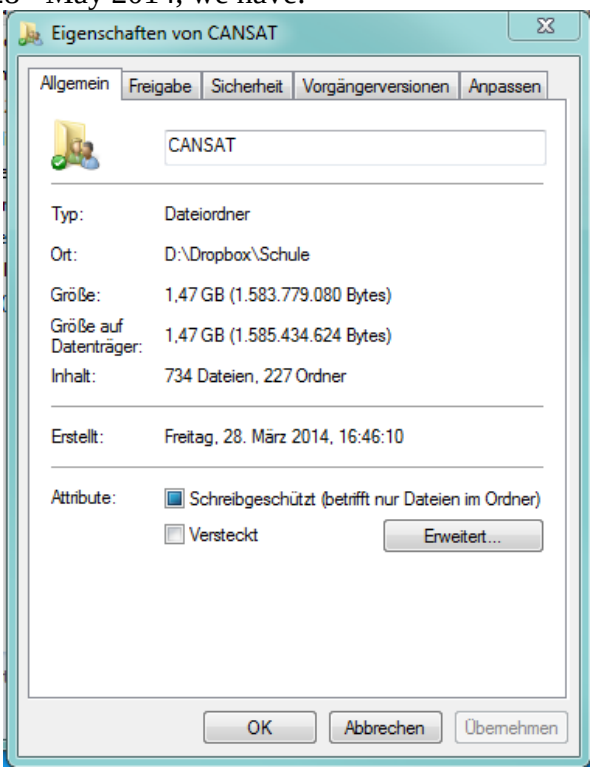


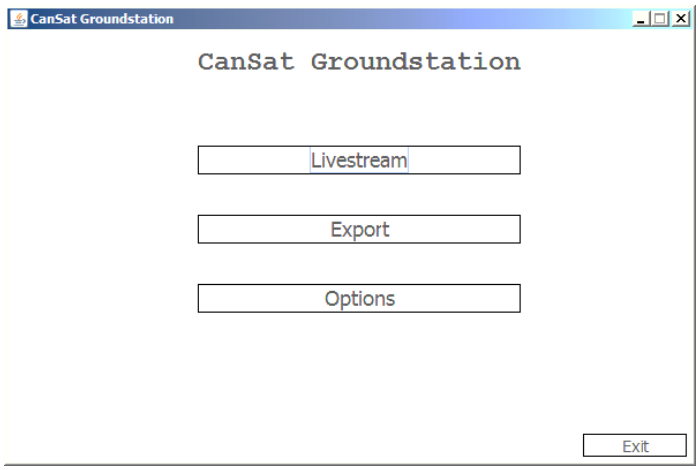
Fig. 36 - Dropbox Folder (Picture: Team Gamma)

Our Dropbox is organized as follows:

1. Ground station
    a. Planning
    b. Libraries
2. Construction and technic
    a. Antenna
    b. Arduino code
    c. Parachute
    d. GPS
    e. JSON
    f. Sensors
3. Organization
    a. Pictures
    b. General documents
        i. Meetings
        ii. CanSat Kit documents
    c. General planning
    d. Documentation
4. Android Application
    a. Code
    b. Data transfer
    c. Planning
    d. Other
5. Issues

This is of course very general and in the Fig. above you can see much more folders and files. Everything is documented in our Dropbox and can be seen upon request.

Appendix A – Ground Station User Manual



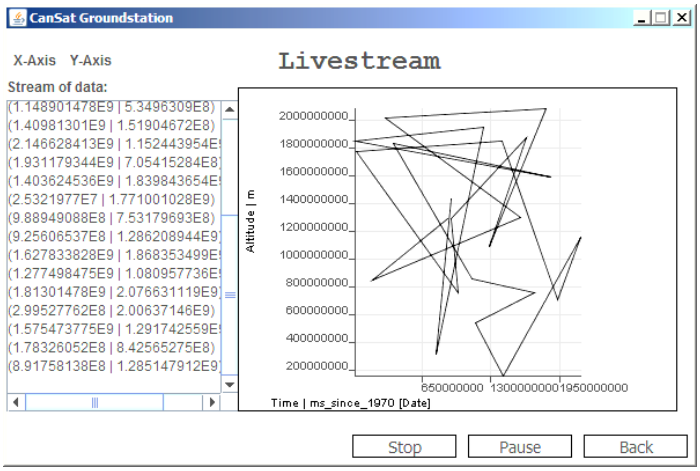
After starting the program a graphical user interface opens, displaying the main menu of the ground station. The main menu offers three options and an exit button to close the application.

Livestream
Pressing the live stream-button takes you to the live stream of the ground station. The live stream is used for processing the received data. For more information on the live stream, see → *A.1*

Export
pressing the export-button takes you to the exporting-options of the ground station. These options give you the ability to process the data that is logged by the live stream. For more information on exporting, see → *A.2*

Options
pressing the options-button takes you to the option menu of the ground station. In the options you can change various things about how the ground station behaves. For more information on the options, see → *A.3*

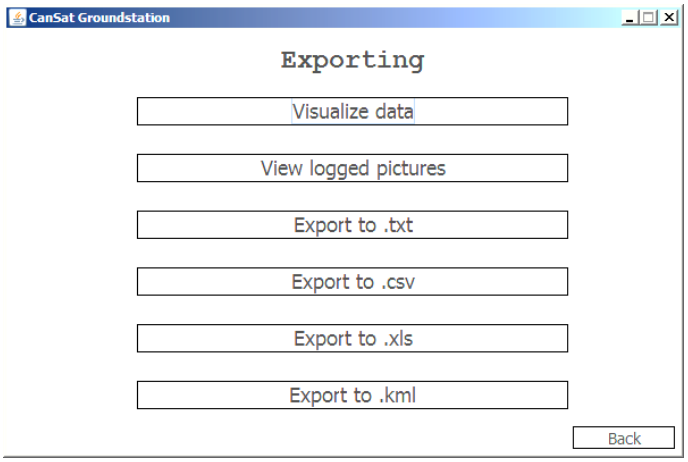
A.1 Livestream



The live stream serves as general communicator between the CanSat, the ground station and the smartphone devices. When starting the live stream, the ground station starts expecting data, eventually forwards the data and logs the data.

The GUI of the live stream consists of a graph to display the received data, a scrollable text field for direct display of the received values, a menu bar offering the ability to adjust the axes of the graph, a stop-button, which stops the receival of data, a pause-button, which pauses only the display of data, and a back-button, which takes the user back to the main menu and ends the live stream.

A.2 Export



The export menu allows for several options to process the data logged by the live stream. Selecting each of these options will open up file browser, asking for input (mostly .csl format) and sometimes even output locations for the data that is supposed to get exported. Pressing the back-button takes you back to the main-menu.

A.2.1 Export to .kml

Selecting this option will allow for an export to the .kml format. This format is used by Google Earth to display routes. In our ground station, exporting to .kml exports the GPS data that is logged by the

ground station to something that can be processed by Google Earth to display the route of the satellite.

A.2.2 Export to .xls

Selecting this option will export the selected data to the .xls format. .xls is a format used by Microsoft Excel and in this case used to display the data in Microsoft Excel, using a table and a graph.

A.2.3 Export to .csv

The .csv export is a simplified version of the .xls format. .csv is a really simple table format and can be imported by every table editor or even databases. In our .csv-export, the first line is used for column names, each column is separated by a comma and each row is separated by a new line.

A.2.4 Export to .txt

The .txt export serves as a really basic export of the collected data to the text format .txt. .txt is the most basic text format. In the exported .txt document only the transmitted data will be found in an easily readable format.

A.2.5 View logged pictures

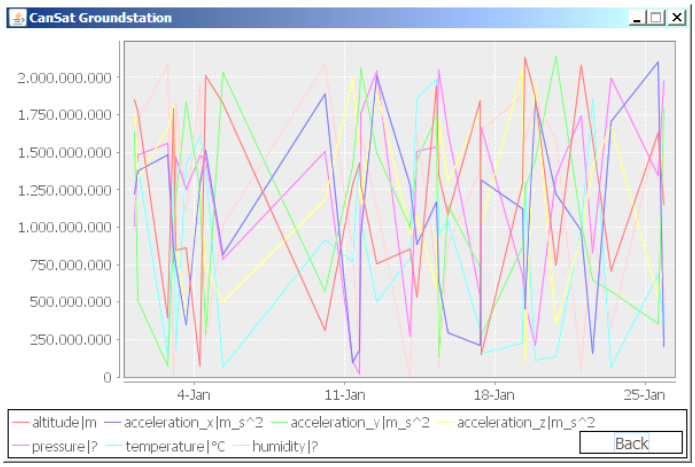
The "view logged pictures" option is used to visualize the pictures taken by the camera on our CanSat.

It displays the selected pictures with the speed the pictures were taken with. Pressing the "Pause" button will pause the video and pressing the "Back" button will take you back to the exporting menu.

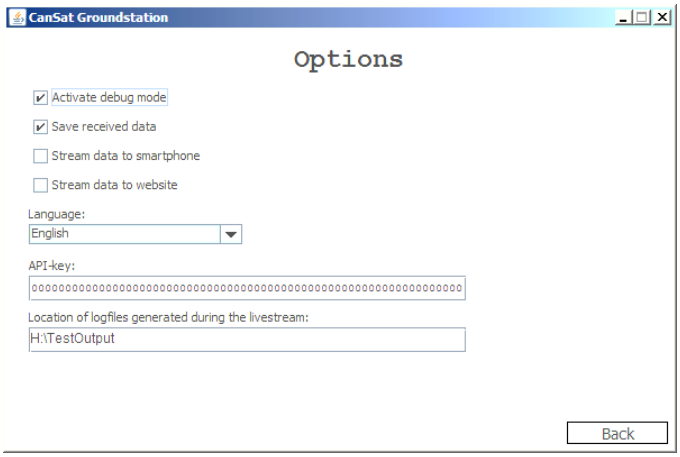
A.2.6 Visualize data

"Visualize data" will visualize the selected data in a graph. You can zoom in on the graph by selecting an area you want to zoom onto. Right clicking onto the graph will give you several more options for the configuration of the graph and also the exporting of the graph.

These options mainly consist of an options-menu to configure the displayed graph, a function to copy the graph to your cache, a function to export the graph to .png, .svg and .pdf, and an option to print the graph.



A.3 Options



"Options" will provide you several options to configure the live stream.

"Activate debug mode" activates a debug live stream where random data is generated instead of received to test the ground station while it is not connected to a CanSat. This option also turns off the automatic FPS-calculation for the exporting option "View logged pictures", so you can test this option with pictures that weren't generated by the camera on our CanSat.

"Save received data" determines if the received data should be logged into a .csl file or not.

"Stream data to smartphone" determines if the received data is being forwarded to the smartphone application.

"Stream data to website" determines if the received data is being forwarded to the database and with that to the website stream.

"Language" allows you to select the language of the ground station.

"API-key" gives you the ability to change the API-key used when communicating with the database that is connected to the website.

"Location of log files" determines the output location of the .csl files logged by the live stream. You can alter this option by clicking on the field that contains the file path.

Appendix B – Android Application User Manual

B.1 General info

When you start our application the first time you have to generate a new options.txt by clicking on the displayed button. If you already have an existing options.txt you can select and open it.

It is quite easy to use our android application. The main navigation is handled by the navigation drawer (slide menu) which can be open by a slide from the left to the right or by pressing the button in the upper left corner of your screen.

When the navigation drawer opens you can choose your favorite element out of a number of displaying elements. I hope this little information will help you to understand how to use the different elements we developed for you.

B.2 Button

B.2.1 Home

Shows the home screen with our website

B.2.2 Sensor names

If you are connected to one of our java socket server you can watch a real time stream of the chosen sensor values here.

B.2.3 Last position

This little point gives you the option to watch the latest GPS position of our satellite in google maps, if it is installed on your phone. This is also only available if you are connected to one of our java socket servers. If you want to watch the landing position of our last flight pleas go to the import interface.

B.2.4 Import

Here you have two options: you can connect to our database or you can import values from a file. If you want to import from a file click on the "browse" button. A new interface will open on which you can select the file you want to open. But if you decide to connect to our database there will be a list of buttons displaying the possible sensors.

B.2.5 Options

If you chose options you have to decide between three different types of option. The "Chart view options" gives you the possibility to change the color of the displaying plot and the number of shown values in a real time chart.

The "Connection" options give you the possibility to enter a port and an IP address of one of our java socket servers and connect to them. Last but not least the "Export" options gives you the possibility to change the director of automatically saved files.

Appendix C – Sensor Pin Out

L3G4200D	SCL		DP26
L3G4200D	SDA		DP25
L3G4200D	SD0		DP24
L3G4200D	CS		DP27
L3G4200D	INT2		DP0
L3G4200D	INT1		DP1
L3G4200D	VCC	Resistor with Z-Diode (3.3 V)	
L3G4200D	GND		GND
MPX4115A	VOUT		DP50 (A0)
MPX4115A	VCC		5V
MPX4115A	GND		GND
MPX4115A	V1		NC
MPX4115A	V2		NC
MPX4115A	VEX		NC
VenusGPS	VCC	see L3G4200D -> VCC	3.3V
VenusGPS	GND		GND
VenusGPS	VBAT	see VCC	3.3V
VenusGPS	MOSI (PIO9)		NC
VenusGPS	MISO (PIO8)		NC
VenusGPS	SPI_CLK		NC
VenusGPS	SPI_CSN		NC
VenusGPS	RXD0		NC
VenusGPS	TXD0		DP 15
VenusGPS	SDA		NC
VenusGPS	SCL		NC
TMP006	SCL		DP 33
TMP006	ADR0		NC
TMP006	DRDY		NC
TMP006	SDA		DP 32
TMP006	ADR1		NC
TMP006	V+		5V
TMP006	GND		GND
SD	CS		DP 5
SD	DI		DP 25
SD	DO		DP 24
SD	CLK		DP 26
SD	5V		5V
SD	GND		GND
SD	3V		NC
SD	CD		NC
HIH	5V		5V
HIH	GND		GND
HIH	A0		A6